2011

Portland – Willamette River Sediment Evaluation Downtown Reach– Phase II Follow-up Summary

Current view of the Willamette looking southwest toward downtown Portland

State of Oregon Department of Environmental Quality

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1.0 Introduction/Background

In the summer of 2008, a collaborative effort by the Oregon Department of Environmental Quality (DEQ), the City of Portland (City), ZRZ Realty Company, Portland General Electric, PacifiCorp, and TriMet was initiated to assess the potential presence of environmental contaminants in sediment within the downtown reach of the Willamette River from River Mile (RM) 12 to RM 16[1] (downtown reach). Eighty-one (81) surface and 36 subsurface samples were collected and analyzed and the results provided in a *Field and Data Report* (GSI Water Solutions, Inc., 2009) submitted to DEQ in January 2009. DEQ evaluated the 2009 data and identified nine focus areas within the downtown reach where additional data collection and/or analysis of archived sediment samples collected during the field effort appeared to be warranted. The additional data proposed by DEQ were designed to achieve the following objectives: (a) confirm detections of elevated levels of contaminants; (b) aid in identifying likely contamination source pathways; (c) assess potential risk posed; and (d) begin to determine the extent of contaminated sediment zones. DEQ's evaluation is summarized in the report *Downtown Portland – Willamette River Sediment Evaluation – Preliminary Identification of Locations of Interest* (DEQ, 2009). Based on the focus area evaluation, PGE agreed to take the lead on follow-up work associated with two of the interest areas (RM 13.1E and RM 13.5E) because of their proximity to current or historical PGE facilities. Information on these two areas is documented in the *Draft Sediment Remedial Investigation Report, River Miles 13.1 and 13.5* (URS, 2011). DEQ contracted with GSI Water Solutions, Inc. (GSI), and Hart Crowser to develop a work plan to conduct the recommended follow-up sampling and analysis at the remaining interest areas (GSI and Hart Crowser, 2010).

PGE, GSI, and Hart Crowser completed the Phase II sampling in March 2010. GSI's Phase II work included analysis of 7 archived grab samples and 15 archived sampling intervals from 10 core stations, 27 new grab surface sediment samples, and 9 new sediment cores. To assess direct toxicity effects, bioassay tests were conducted on sediment samples from five locations where DEQ identified elevated contamination. PGE's work included sampling surface and subsurface sediments within a spatial grid as well as sampling beach sediment in the RM 13.1E and RM 13.5E areas. Data reports for both investigations were finalized in June 2010 (GSI, 2010; URS, 2010). Figures presented in this report are taken from the GSI data report. Figure 1 shows the study area highlighting the Phase II data collection locations. Note that in addition to collecting data at the focus areas identified in Phase I, sediment data also were collected in the alignment for the planned Tri-Met bridge under a contract with Tri-Met.

This report summarizes key findings of the Phase II work completed by GSI and recommends next steps for each of the identified focus areas. In addition, this report provides a summary analysis of the data collected throughout the downtown reach using methods that allow for general comparisons to data collected in the downstream Portland Harbor Superfund Site of the Willamette River from RM 1.9 to 11.8 (Portland Harbor). Note that outfalls within the downtown reach have not been fully mapped and, for areas where follow-up actions have been recommended, additional investigation of outfalls and associated drainage basins may be warranted. Specific recommendations associated with the RM 13.1E and RM 13.5E areas being addressed by PGE under a cleanup oversight agreement with DEQ will be presented separately.

2.0 General Observations

The data collected for the Phase II work generally indicate lower concentrations of contaminants of concern than the Phase I data that resulted in the area being identified as an "area of interest." Consequently, DEQ has identified three areas (RM 12.1E, RM 12.5E, and RM 12.9W) where some follow-up evaluation appears to be warranted, but rated the need for follow-up as a low priority because contaminants generally are present at low concentrations, over small areas, and unlikely to pose a significant risk to human health and the environment.

[1] Portland Harbor Superfund Site Remedial Investigation defines the downtown reach as RM 11.8 to RM 15.3.

In addition, DEQ has identified one area (RM 15.1E) for possible follow-up to assess potential residual contamination in stormwater lines that discharge to the area.

Significant sediment investigations and, in some cases, sediment cleanup actions have occurred or are taking place at the following locations within the downtown reach:

1. Zidell facility – Sediment remediation is being implemented this summer.
2. PGE – Remedial investigation/source control evaluation at RMs 13.1 and RM 13.5 has been conducted. Next steps are under discussion between PGE and DEQ.
3. Portland Gas Manufacturing – Remedial investigation in progress.
4. Ross Island – Cleanup is complete.
5. PGE Station L – Cleanup is complete.

In addition, several active cleanup projects are located in the upland drainage areas to this reach, including shoreline projects adjacent to the RM 13.3E and RM 14.1W focus areas.

DEQ is not recommending additional in-river investigation at any other locations within the downtown reach at this time. Other identified contaminant focus areas appear to have limited extent and, in some cases, data suggest that natural recovery processes are occurring. The four areas identified above (RM 12.1E, RM 12.5E, RM 12.9W, and RM 15.1E) will be referred to DEQ's Site Assessment program for evaluation of potential sources based on their priority relative to other sites under evaluation by DEQ.

All available surface sediment data for this reach were utilized to develop surface weighted average concentrations for potential contaminants of concern as a means of comparing contamination in this section of the Willamette River to the Portland Harbor. This evaluation is summarized in Section 4.

3.0 Focus Area Evaluations

Data summaries and implications for each of the identified "areas of interest" are presented in the following sections.

3.1 RM 12.1E Focus Area

This area is located just south of the Steel Bridge beneath the Interstate 5/Interstate 84 interchange and adjacent to the East Side esplanade floating path. Contaminants of initial concern identified from the Phase I work included the pesticides: DDTs, dieldrin, chlordanes, polychlorinated biphenyls (PCB), lead, and dioxins. There are two identified stormwater outfalls of potential concern in this area: OF 40 and WR-309. Phase II sampling was targeted to attempt to identify the outfall most likely to be the source for contaminants detected in the sediment. While other outfalls are present in this segment, they appear to drain mainly highway runoff and were not expected to be a significant source of PCBs and pesticides. Sample locations are shown in Figure 2 and the pertinent data are presented in Table 1.

Table 1. RM 12.1E Data Summary Table

Sample/ Contaminant	Total DDTs (ppb)	Total PCBs (ppb)	Dieldrin (ppb)	Lead (ppm)	Chlordanes (ppb)	TCDD (ppt) TEQ	Notes
SLV	0.33	0.39	0.0081	17	0.37	0.0091	PAH TEQ 3021.3 ppb bis(2e,h)phthalate 330 ppb
C031C (129 – 199 cm)	300.5/73.13	239/NA	7.45/16	371/NA	8.1/8.3	5.04/NA	
C031B (30 – 129 cm)	35.1/NA	520/NA	4.5/NA	NA/NA	NA/3.82	NA/NA	
C031A (0 – 30 cm)	14.1	185	1	NA	NA	NA	
G063	1.1	6.9	ND (0.1)	21	0.24	NA	
G064	2.92	5.7	0.28	23.4	1.24	3.01	
G065	5.25	28	ND (0.2)	40.35	ND (0.36)	NA	
C087 (0 – 30 cm)	0.95	ND	ND	12.5	0.189		PAHs elevated: 4,825 ppb TEQ
G086	26	330		70.4	4.1		
C086 (30 – 91 cm)	22.1	147	ND	459	7.67	NA	
LW3-GCRSP12E	16	134 (aroclors) 912 (congeners)	ND	90.1	ND	4.86	bis(2e,h)phthalate 18,000 ppb
LW3-GCA12E	4.7	171 (aroclors) 609 (congeners)	ND	66.7	4.2	6.2	

	Screening level (SL)
	Significant elevation (100 X bioaccumulation SL, 10X toxicity SL)
	Exceeds SL
	Initial sample(s) with elevated concentrations of concern [initial result/Phase II result (if applicable)]

NA = not applicable
ND = not detected or non-detect
ppt = parts per trillion
ppb = parts per billion
ppm = parts per million

Follow-up

While analysis of archived samples at C031 indicates PCBs are elevated in the upper intervals of sediment as well as the deeper sediment, the sample collected at C087 to assess OF 40 was non-detect for PCBs. Proximal sample G064 had PCBs on the order of upriver background. Lead was elevated at depth in C031, but not in surrounding surface sediment. The dioxin TEQ was moderately elevated compared to upriver. In-river sediment trap data collected by the City indicate low concentrations of total PCBs in water-born sediment downstream from this area, with increasing concentrations farther downstream (see Figure 3), suggesting minimal movement of contamination from this area.

There is not definitive evidence of a significant sediment contamination source in the OF 40 area. In addition, the City currently is constructing a conveyance system to direct all of the OF 40 drainage to the Columbia Boulevard Treatment Plant so there will be no further stormwater releases from this outfall. Follow-up site discovery work for potential upland contamination sources in the OF 40 drainage is a low priority.

The samples near outfall WR-309 more consistently indicate elevated PCBs. Lead was elevated at depth in C086 and somewhat elevated in surface sediment in the Lower Willamette Group (LWG) samples. Dioxin TEQ is moderately elevated compared to background. Investigation of potential sources in the WR-309 drainage basin is warranted.

3.2 RM 12.4W Focus Area

This area (see cover photo) is located south of the Burnside Bridge near the Sternwheeler dock and was identified as a focus area primarily because of elevated polycyclic aromatic hydrocarbons (PAH) in sample G003. Mercury also was elevated in this sample. Phase II sampling consisted of collecting an additional surface sample in this area and conducting bioassays[2] on it. Sample locations are shown in Figure 4 and data highlights presented in Table 2.

Table 2. RM 12.4W Data Summary Table

Sample/Contaminant	Mercury (ppm)	Indeno(1,2,3-cd)Pyrene (ppb)	Naphthalene (ppb)	Acenaphthene (ppb)	Notes
SLV	0.07	100	561	200	
G003	4.06	1,400	5,300	1,900	
G088	0.061	37	45	18	No indication of toxicity in bioassay

	Screening level (SL)
	Significant elevation (100 X bioaccumulation SL, 10X toxicity SL)
	Exceeds SL
	Initial samples with elevated concentrations of concern

ppb = parts per billion
ppm = parts per million

[2] Bioassays are used to assess whether contamination in the sediment is toxic to organisms that live in the sediment. The following bioassays were run on samples identified for toxicity analysis: 10-day *Chironomus dilutus* (previously *C. tentans*) survival and growth test by ASTM Method E-1706 and EPA/600/R99/064, Method 100.2 and 28-day *Hyalella azteca* survival and growth test by ASTM Method E-1706, EPA/600/R-99/064 Method 100.4 (modification to 28 days).

Follow-up
The follow-up sampling in this area did not indicate any elevated contaminants and the bioassay showed no indication of toxicity. DEQ considers the need for follow-up evaluations in this area to be a low priority. Sediment investigation near OF 09 is being conducted as part of the Portland Gas Manufacturing site investigation (DEQ Environmental Cleanup Site Information [ECSI] site #1138). This sampling may result in a determination that sediment contamination is associated with historical discharges from the gas manufacturing facility or that sediment contamination is more likely the result of other sources contributing stormwater runoff to this outfall. In the latter case additional site discovery may be recommended.

3.3 RM 12.5E Focus Area

This area is located just north of the Morrison Bridge in the discharge area of several outfalls. Contaminants of concern identified in Phase I included pesticides, PCBs, metals, and dioxin. Archived samples were analyzed to confirm pesticide detections and assess dioxin distribution. Additional samples were collected in the immediate vicinity of outfalls WR-315 and WR-313 to determine their significance in terms of potential contaminant source locations and help to refine the focus of site discovery efforts in this area. Sample locations are shown in Figure 5 and data highlights presented in Table 3.

Table 3. RM 12.5E Data Summary Table

Sample/ Contaminant	Dieldrin (ppb)	PCBs (ppb)	DDTs (ppb)	TCDD TEQ (ppt)	Lead (ppm)	Mercury (ppm)	PCP (ppb)	Chlordane (ppb)	Notes
SLV	0.0081	0.39	0.33	0.0091	17	0.07	250	0.37	
G058	6.7/ND (0.008)	49.8/NA	10.5/ 2.896	2.89/NA	41.5/NA	0.063/NA	35/NA	1.9/1.048	
C030 (30 – 99 cm)	ND (0.036)	ND (1.0)	ND (0.13)	0.052	3.31	0.012	4.4	ND (0.52)	
G057	ND (0.36)	35.13	2.3	9.95	63.6	0.154	890	3.38	
G054	ND (0.18)/ ND	260/NA	19.2/ 20.14	3.96/NA	103/NA	0.071/NA	33/NA	6/23.2	
C028 (30 – 58 cm)	ND (0.036)	47	12.73	3.85	174	0.993	ND (5.2)	1.2	
G055	ND (0.26)	63	13.3	1.53/1.43	306	0.045	ND (4.8)	1.8	
G056	0.45	13.2	7.78	5.42	122	0.097	ND (4.0)	1.32	
C029C (53 – 157 cm)	ND (0.036)	7.1	2.39	4.13	90.3	1.32	ND (5)	ND (0.2)	
C029B (30 – 142 cm)	NA	NA	NA	NA	109	0.271	NA	NA	
C029A (0 – 30 cm)	NA	NA	NA	NA	232	29.2	NA	NA	
G089	0.2	8.3	1.04	3.2	18.7	0.168	NA	ND	
C089B (30 – 87 cm)	ND	3.4	1.06	1.079	13.7	0.067	NA	0.13	
C090A (0 – 30 cm)	ND	279	72.2	9.271	69	0.21	NA	0.74	TPH – 2,260 ppm
C090B (30 – 91 cm)	ND	77	8.2	2.85	46.5	0.189	NA	0.37	

	Screening level (SL)
	Significant elevation (100 X bioaccumulation SL, 10X toxicity SL)
	Exceeds SL
	Initial samples with elevated concentrations of concern [initial result/Phase II result (if applicable)]

NA = not applicable
ND = not detected or non-detect
ppt = parts per trillion
ppb = parts per billion
ppm = parts per million

Follow-up
The samples collected near outfall WR-313 indicate low priority for follow-up associated with this outfall. The concentration of dieldren, which was the primary driver for priority at sample location G058, was lower in the additional samples. The consistent levels of PCBs at C090A and elevated levels of DDTs and dioxin with decreasing concentrations with depth suggest there may be a source of concern near outfalls WR-315 and OF 36. C090 is somewhat upstream of OF 36, so initial focus should be on WR-315. In addition, much of the OF 36 drainage area will be routed to the Columbia Boulevard Treatment Plant, so future releases should be minimal.

3.4 RM 12.9W Focus Area

This area is located near and to the north of the Hawthorne Bridge along the seawall that supports the south waterfront park. The objective of the Phase II work was to assess toxicity along the seawall where PAHs were elevated and to further characterize the sediment near OF 08A to aid in determining if releases may be current. Sample locations are shown in Figure 6 and data highlights are presented in Table 4.

Table 4. RM 12.9W Data Summary Table

Sample/ Contaminant	TBT (ppb)	Arsenic (ppm)	Lead (ppm)	PCBs (ppb)	Indeno(1,2,3 -cd)pyrene (ppb)	DDTs (ppb)	Chlordanes	TCDD TEQ (ppt)	Bioassay Result or Other Notes
SLV	2	7	17	0.39	100	0.33	0.37	0.0091	
G006	1.7	126	428	38	1100	4.15	0.94	NA	
G007	40	12.7	60.1	150	220	15.55	3.6	3.26	
C002 (30 – 85 cm)	7.3	6.02	123	141	66	26.2	4.3	4.13	
G005	1700	5.4	197	9.5	64	2.12	0.25	NA	
G091	0.48	2.71	16.2	2.4	3	1.03	0.17	NA	
G092	53.3	3.65	17.4	4.9	14	2.07	ND	NA	
G093	5.5	13.3	214	12	50	4.98	0.06	NA	Failed *Hyalella*
G094	8.6	61.5	457	5	51	3.57	0.28	1.012	Cu at 366 ppm Zn at 1,450 ppm No toxicity
G095	33.3	2.46	62.5	57	31	0.68	ND	0.517	Slight toxicity *Hyalella*
C095	2.05	2.25	1.0	8.6	55	1.48	ND	0.52	

	Screening level (SL)
	Significant elevation (100 X bioaccumulation SL, 10X toxicity SL)
	Exceeds SL
	Initial samples with elevated concentrations of concern

NA = not applicable
ND = not detected or non-detect
ppt = parts per trillion
ppb = parts per billion
ppm = parts per million

Follow-up

The samples along the seawall have relatively low levels of contaminants, which may be associated with ships that dock in this area or historical activities along the shoreline. There is no clear indication of what caused the toxicity in G093 and G095; however, anthropogenic material (non-natural debris) was noted in the sample notes for G093 as well as a sparse, iridescent sheen. No follow-up is recommended along the seawall at this time. The samples collected near OF 08A show elevated concentrations of PCBs. Discharge at OF 08A is limited to stormwater and much of the drainage area (approximately 40 percent) is residential. The City has required that stormwater management measures be implemented in conjunction with redevelopment activities in this drainage basin. Evaluation of potential sources in this outfall basin may be warranted, but is a low priority.

3.5 RM 13.3E Focus Area

This area is located where the Marquam Bridge meets the east side of the Willamette River and is just downstream from the PGE Station L sediment cap. Contaminants of potential concern identified during the Phase I study include dioxins, naphthalene, DDTs, and PCBs. Phase II work focused on trying to assess which of several outfalls may be sources of contamination and evaluating the toxicity of sediment in this area. Sample locations are shown in Figure 7 and data highlights presented in Table 5.

Table 5. RM 13.3E Data Summary Table

Sample/Contaminant	PCBs (ppb)	DDTs (ppb)	Naphthalene (ppb)	TCDD TEQ (pg/g)	Bioassay Result
SLV	0.39	0.33	561	0.0091	
G045	62	7.48	3400	15.02	
C024B (30-99 cm)	ND	ND	3700	0.01	
C024C (99 – 142 cm)	ND (1.0)	ND (0.2)	290	0.011	
G044	17	1.056	140	8.12	
C023 (31 – 80 cm)	ND (1.0)	ND (0.13)	740	0.05	
G046	14	4.78	12	1.16	
G096	21.4	1.63	2	NA	No toxicity
G097	2.8	1.15	2.5	NA	

	Screening level (SL)
	Significant elevation (100 X bioaccumulation SL, 10X toxicity SL)
	Exceeds SL
	Initial sample(s) with elevated concentrations of concern

NA = not applicable
ND = not detected or non-detect
ppt = parts per trillion
ppb = parts per billion
ppm = parts per million

Follow-up

Additional samples did not indicate contamination on the order of magnitude of the original sample of concern and the bioassay did not indicate toxicity.

A Phase II investigation and source control evaluation currently are being conducted at the Crescent Site (ECSI # 5547), located just north of the Marquam Bridge overpass along the bank of the Willamette River. Erodible soils, catch basin solids, dry well samples, stormwater, and upland soil samples will be collected and analyzed for PCBs, eight Resource Conservation and Recovery Act (RCRA) metals, Total Petroleum Hydrocarbons (NWTPH), PAHs, and volatile organic compounds (VOC). Any necessary source control measures at this site will be addressed as part of site development.

The dioxin TEQ is elevated in surface sediment in this area. This may be related to historical upland activities associated with PGE Station L, pole storage areas, and other industrial activities. However, the total organic carbon was also elevated in this sample (14 percent compared to less than 4 percent for most other samples in the downtown reach). The normalized dioxin concentration would not stand out as elevated and the presence of organic carbon would make the dioxin less bioavailable. Potential sources of dioxin will be considered in reviewing the preliminary assessment completed by PGE for this drainage area.

3.6 RM 14.1W Focus Area

This area is located south of the Ross Island Bridge just across from the northern tip of Ross Island. Contaminants of concern identified in Phase I included pesticides, PCBs, metals, and dioxin. Archived samples were analyzed to confirm pesticide detections and assess the distribution of PCBs, pesticides, and dioxin. Additional samples were collected to provide an indication of contaminant extent. Sample locations are shown in Figure 8 and data highlights presented in Table 6.

Table 6. RM 14.1W Data Summary Table

Sample/Contaminant	Total PCBs (ppb)	Total DDTs (ppb)	Lead (ppm)	Total chlordanes (ppb)	TCDD TEQ (ppt)
SLV	0.39	0.33	17	0.37	0.0091
G017	520/110	70.3/0.63	57.5/NA	15/0.32	0.95/NA
C008B (30 – 130 cm)	62	8.24	23.5	1.62	3.69
C008C (130 – 362 cm)	46	7.7	NA	0.59	5.2
C036A (0 – 60 cm)	51	6.81	83	ND (1.5)	3.87
C036 (60 – 68 cm)	24	3.8	49	ND (0.23)	NA
C037 (0 – 60 cm)	75	10.35	33	1.9	NA
C037 (60 – 68 cm)	26	3.29	14.9	1.3	NA
C007A (0 – 30 cm)	21.8	3.19	NA	1.24	3.12
C007C (88 – 210 cm)	21	8.8	17.8	0.57	12.75
G016	60	8.2	40.5	2.2	1.58
C035A (0 – 61 cm)	41	11.4	51.4	1.6	NA/4.82
C039 (60 – 120 cm)	538	7.17	11.52	ND (0.98)	NA
C039 (0 – 60 cm)	46	1.05	16.1	ND (0.9)	NA
C038 (0 – 60 cm)	ND (1.0)	ND (0.13)	30.15	ND (0.22)	NA
C038 (60 – 120 cm)	ND (1.0)	0.13	14.4	ND (0.22)	NA
C009 (30 - 182 cm)	19.6	4.09	9.62	0.47	1.17
G018	39	4.58	102	1.49	2.28
G076	ND/NA	ND	17/NA	0.37	NA/0.03
G104	11.8	0.88	12.6	0.34	NA
G106	2.6	0.58	9.89	0.237	NA
G108	1.4	0.3	5.77	ND	NA
G109	ND	0.051	4.98	ND	NA
G112	10.9	1	9.38	0.41	NA

Sample/Contaminant	Total PCBs (ppb)	Total DDTs (ppb)	Lead (ppm)	Total chlordanes (ppb)	TCDD TEQ (ppt)
SLV	0.39	0.33	17	0.37	0.0091
C112	ND	0.139	3.4	ND	NA

	Screening level (SL)
	Significant elevation (100 X bioaccumulation SL, 10X toxicity SL)
	Exceeds SL
	Initial sample(s) with elevated concentrations of concern

NA = not applicable
ND = not detected or non-detect
ppt = parts per trillion
ppb = parts per billion
ppm = parts per million

Follow-up

Additional samples did not indicate contamination on the order of the original sample of concern. Some elevated contamination along the immediate shoreline and an apparently limited area of PCB-contaminated surface sediment likely reflect historic releases. Some upland removal of PCB-contaminated soil was conducted in 2009. Additional source evaluation is being conducted by the Portland Development Commission (PDC) with DEQ oversight as part of proposed site redevelopment associated with the CD Greenway property (ECSI #5277). The presence of contaminated sediments and the need to prevent erosion of any contaminated shoreline soils identified as part of the PDC evaluation will be considered as part of the redevelopment process.

3.7 RM 15.1E Focus Area

This area is located across the Holgate Slough from Ross Island near OF 28. Contaminants of concern identified in Phase I included PCBs, pesticides, lead, and dioxin. Additional samples were collected to provide an indication of contaminant extent. Sample locations are shown in Figure 9 and data highlights presented in Table 7.

Table 7. RM 15.1E Data Summary Table

Sample/Contaminant	Total PCBs (ppb)	Total DDTs (ppb)	Lead (ppm)	Total chlordanes (ppb)	TCDD TEQ (ppt)
SLV	0.39	0.33	17	0.37	0.0091
G030	710	40.7	389	15.9	19.22
C018 (30 - 122 cm)	ND (7.4)	0.89	13.3	0.12	0.47
G113	ND (1.3)	0.069	4.3	ND (0.11)	0.336
G114	ND (1.3)	0.054	3.76	ND (0.13)	1.131
G115	25	6.7	29	0.71	3.27
G116	ND (1.3)	1.01	20.1	0.083	1.388

	Screening level (SL)
	Significant elevation (100 X bioaccumulation SL, 10X toxicity SL)
	Exceeds SL
	Initial sample(s) with elevated concentrations of concern

ND = not detected or non-detect
ppt = parts per trillion
ppb = parts per billion
ppm = parts per million

Follow-up
Additional samples did not indicate contamination on the order of magnitude of the original sample of concern. There may be a limited area of elevated contamination immediately downstream from OF 28. Stormwater flow in this drainage basin will be diverted to the Columbia Boulevard Treatment Plant. DEQ considers additional follow-up evaluation a low priority. Sampling of potential residual solids in the stormwater line may be warranted to assess for the presence of residual contamination in the line and identify any associated contaminated upland sites for further cleanup evaluation.

3.8 Follow-up Summary

Table 8 summarizes recommended next steps for the downtown reach of the Willamette River bounded by RM 12 and RM 16. Note that DEQ considers all future site discovery work a low priority at this time based on the magnitude and apparent limited extent of surface sediment contamination.

Table 8. Downtown Willamette Recommendations

Priority Area	Recommended Actions
RM 12.1E	Site discovery – focus on WR-309 drainage basin
RM 12.4W	Reassess priority following completion of the PGM investigation
RM 12.5E	Site discovery – focus on WR-315 drainage basin
RM 12.9W	Site discovery – focus on OF 08A
RM 13.1E	Continue to work with PGE to evaluate source control/sediment cleanup needs
RM 13.3E	Assess possible dioxin sources as part of PGE preliminary assessment review
RM 13.5E	Continue to work with PGE to evaluate source control/sediment cleanup needs
RM 14.1W	Address need for controls as part of shoreline development work
RM 15.1E	Sample sediments in stormwater lines that drain to OF 28

4.0 Reach-Wide Evaluations

Summary statistics, including surface weighted average concentrations (SWAC), were compared between the downtown reach and the Portland Harbor to assess the potential for the downtown reach to be a source of contamination to the Portland Harbor that could impede remedy implementation following the U.S. Environmental Protection Agency's (EPA) issuance of the Record of Decision. The small number of surface sediment samples collected relative to the area of the downtown reach presents several issues with the weighted average calculation, which was computed using Theissen polygons. For example, several polygons extend almost across the river suggesting that the concentration on the east side of the Willamette River extends over a large area including the mid-channel and portions of the western half of the river. Because data are concentrated in likely source areas near the shoreline, DEQ assumes that the resulting SWAC for the downtown reach is likely higher than the actual average concentration for the reach. This would be consistent with a study DEQ completed on a segment of the Columbia Slough in which discrete data were collected near several outfalls and known shoreline contamination areas and an incremental sample (IS) (30 subsamples spread throughout the reach composited into a single sample following established protocols) was collected for the entire 2-mile segment. In the 2-mile segment of the Columbia Slough, the IS concentration of total PCBs was 45.5 parts per billion (ppb) while the SWAC based on Theissen polygons constructed around the source-focused discrete sample data points was 92.7 ppb. For dieldren, the IS concentration was 0.7 ppb and the SWAC was 1.8 ppb.

Other issues with weighted average concentrations include how to incorporate non-detect (ND) values. For this evaluation of the downtown reach sediment samples, the Lower Willamette Group (LWG) Risk Assessment (RA) data rules were utilized in the calculation of analyte group totals. These rules include the following steps, which are likely to bias the resulting average concentration high:

1. If no individual analytes are detected in an analyte group, then the highest detection limit from all individual analytes is utilized as the reported value.

2. If any individual analyte is detected, the calculated total for the analyte group is reported as the sum of the detected value and one half the detection limit for non-detected analytes.

The data utilized in the SWAC calculations include all surface sediment data presented in the *Draft Portland Harbor RI/FS Feasibility Study Sediment Database*, prepared by the LWG in March 2011. Data have been reduced such that for each analyte only one result is included for each surface sediment sample location. If

more than one result were reported for a particular sample location (e.g., two different samples were collected at different depths at the same location or a sample was re-analyzed), then the highest reported result was retained for this analysis. In instances where samples were analyzed for organochlorine pesticides by both EPA methods E1699M (high resolution) and 8081A (standard resolution), the high resolution results were utilized. Note that total PCB results from five archived PGE samples (URS, 2011), not included in the draft Portland Harbor database, have been incorporated into this analysis.

Finally, because the Zidell site cleanup is capping sediment contamination near that site, the SWAC was calculated with and without the Zidell data by clipping the Theissen polygon layer to the Zidell sediment management area and re-calculating the SWACs based on the resultant polygon layers.

The comparison of Portland Harbor and downtown reach data is presented in Table 9 (presented at the end of this report) and shown graphically in Figure 10. With the exception of mercury, concentrations of primary contaminants of concern are significantly higher in Portland Harbor than in the downtown reach.

5.0 Summary

DEQ does not plan to perform further evaluation of the downtown reach as a whole. Investigation will continue at the active cleanup projects and some site discovery work, discussed above, will occur as DEQ resources are available.

DEQ expects that concentrations of contaminants in surface sediments in this portion of the Willamette River will decline over time as source areas are addressed, upland sources are controlled, and natural recovery mechanisms take effect.

The Downtown Portland Sediment Characterization has achieved the goals it set out to complete. The two phases of investigation have shown that while there are areas with elevated contaminants in this reach of the Lower Willamette River, the most significant areas have or are being remediated under DEQ's Cleanup Program. The second phase of investigation indicated that the extent of contamination in the identified focus areas is limited. A broader statistical analysis of the downtown reach surface sediment data shows that concentrations of contaminants of concern are significantly lower than those found in the Portland Harbor. As a result, DEQ has concluded that contamination present in the downtown reach is not a significant ongoing source of contamination to the Portland Harbor.

References

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Table 9: Downtown Reach/Portland Harbor Surface Sediment Statistics

Analyte (units)	Units	Downtown Reach (RM 11.8-15.3)				Downtown Reach Excluding Zidell Data[1] (RM 11.8-15.3)				Portland Harbor (RM 1.9-11.8)			
		Median	Mean	Maximum	SWAC[2]	Median	Mean	Maximum	SWAC[2]	Median	Mean	Maximum	SWAC[2]
Total PCBs	µg/Kg	39	480	20,000	44	22	92	4,500	28	33	210	35,000	81
Total PAHs	µg/Kg	280	2,000	63,000	680	180	1,500	63,000	660	1,200	27,000	7,300,000	19,000
Total Chlordane[3]	µg/Kg	0.955	1.8	24	1.0	0.955	1.8	24	1.0	1.2	6.7	700	2.2
Total DDx[3]	µg/Kg	2.8	6.1	73	4.4	2.8	6.1	73	4.4	7.4	250	85,000	33
Total Dioxin/Furan TEQ[3]	pg/g	1.25	2.4	19	1.2	1.25	2.4	19	1.2	1.4	69	14,000	15
Arsenic	mg/Kg	2.79	5.5	126	3.0	2.65	4.2	126	2.9	3.6	4.6	132	3.9
Cadmium	mg/Kg	0.205	1.2	132	0.25	0.157	0.44	6.5	0.23	0.247	0.39	10.1	0.29
Lead	mg/Kg	21.85	200	20,800	28	17.2	41	457	24	15.5	48	13,400	23
Mercury	mg/Kg	0.05055	0.38	29.2	0.16	0.040	0.26	29.2	0.15	0.063	0.14	65.2	0.093

Notes:

DDx = sum of 2'4- and 4'4- DDD, DDE, and DDT
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RM = River Mile
SWAC = Surface Weighted Area Concentration
TEQ = toxic equivalent
Two significant figures have been retained for the Mean and SWAC calculations.

Source of data is the Draft Portland Harbor RI/FS Feasibility Study Sediment Database, prepared by the Lower Willamette Group (LWG) in March 2011 (Anchor QEA, 2011) . Results are provided for surface sediment consisting of samples with a start depth of zero and end depth of less than or equal to 40 centimeters (cm). This dataset utilized the Portland Harbor Risk Assessment (RA) data rules in the calculation of analyte group totals. These rules specify that if no individual analytes are detected in the analyte group, then the highest method detection limit (MDL) from all individual analytes is utilized as the reported value and the result is flagged as non-detect ("U" qualifier). Furthermore, calculated totals are the sum of all detected results and non-detected results at one half the MDL. This method of including non-detected results at half the MDL may cause the calculated total concentration to be biased high, especially when the MDLs are elevated. For individual analytes (e.g., arsenic, cadmium, lead, and mercury), non-detected results are included at half the MDL in statistical determinations. Data have been reduced such that only one result is included for each surface sediment sample location, for each analyte. If more than one result were reported for a particular sample location (e.g., two different samples were collected at different depths at the same location or a sample was re-analyzed), then the highest reported result was retained for this analysis. In instances where samples were analyzed by both U.S. Environmental Protection Agency (EPA) methods E1699M (high-resolution) and 8081A (standard resolution), the high resolution results were utilized. In addition, the total PCB results from five archived PGE samples (URS, 2011), not included in the draft Portland Harbor database, have been incorporated into this analysis.

[1] Construction of the sediment cap within the Zidell Sediment Management Area (SMA) is planned for 2011, thus the Downtown Reach statistics were calculated both with and without the data that fall within the Zidell SMA to reflect current and future conditions.

[2] Surface Weighted Area Concentration (SWAC) -- A spatially weighted estimate that describes an average sediment concentration throughout the study area. The SWAC was calculated as the sum of a series of products of normalized Thiessen polygon areas and associated (by sampling location) sediment concentrations. The SWAC results are sensitive to the manner in which non-detected results are treated in the calculations. The SWACs in this table reflect the Portland Harbor RA rules, and thus include non-detected constituents at half the MDL. When the SWAC calculations are performed on results calculated using the Remedial Investigation (RI) data rules, which exclude non-detected constituents in the calculation of analyte group totals, the associated SWAC calculations are lower than those reported in this table. For example, using the RI rules, and including non-detected analyte group totals at the highest MDL (which is also consistent with the RA rules), the associated total PCB SWACs for the Downtown Reach, the Downtown Reach excluding Zidell data, and the Portland Harbor Study area are approximately 38 µg/Kg, 24 µg/Kg, and 66 µg/Kg respectively. If non-detected totals are included as zero values (rather than the MDL) in the RI SWAC calculations, the total PCB SWAC concentrations are further reduced to approximately 30 µg/Kg, 17 µg/Kg, and 59 µg/Kg, respectively.

[3] No chlordane, DDx, or dioxin/furan data were collected within the Zidell SMA, thus the statistics for the Downtown Reach and the Downtown Reach excluding Zidell data are equivalent.

Figure 1

Sediment Sampling Locations

Overview

Downtown Portland Sediment Characterization Phase II Field and Data Report

Willamette River
Portland, Oregon

RM 12.1 EAST
RM 12.5 EAST
RM 12.4 WEST
RM 12.9 WEST
RM 13.1 EAST
RM 13.3 EAST
RM 13.5 EAST
TRIMET SUPPLEMENTAL SAMPLING
RM 14.1 WEST
RM 15.1 EAST
RM 13
RM 14
RM 15
RM 16
Willamette River
Marquam Bridge
Ross Island Bridge
Hawthorne Bridge
Morrison Bridge
Steel Bridge
Burnside Bridge
Broadway Bridge
Fremont Bridge
RIVER PKWY
NAITO PKWY
I-5 FWY
I-405 FWY
I-84 FWY

LEGEND

- DPSC Phase II Focus Areas

DPSC Phase II Sediment Sample Location

- Grab Sample
- Core Sample
- Unsuccessful Grab Sample

Archived DPSC Phase I Sediment Sample Location

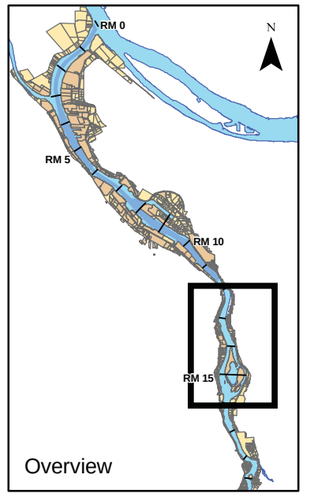
- Grab Sample
- Core Sample

Existing[7] Sediment Sample Location

- Grab Sample
- Core Sample

Other Data and Features

- DEQ Cleanup Site (ECSI#)
- Active Outfalls
- Outfalls with Inactive, Abandoned, or Unknown Status
- Combined Sewer/Stormwater Pipeline
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- PGE Station L Sediment Cap, Approximate
- Zidell - DEQ Sediment Management Area
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: June 11, 2010

1. The locations of all features shown are approximate.
2. DPSC = Downtown Portland Sediment Characterization.
3. PP&R = Portland Parks & Recreation.
4. RM11E = River Mile 11 East.
5. LWG = Lower Willamette Group.
6. ECSI = Environmental Cleanup Site Information (information current as of April 2, 2010).
7. Existing data includes DPSC Phase I, PP&R, RM11E, and LWG data.
8. Source of existing sediment sample locations is LWG SCRA Combo database (dated October 29, 2009), DPSC Field and Data Report (dated January 2009), and Draft RM11E Surface and Subsurface Sediment Field and Data Report (dated August 2009). Other sediment data might exist that are not included in the LWG SCRA Combo database or the DPSC Field and Data Report.
8. Outfall, combined sewer/stormwater pipeline, and stormwater pipeline data provided by the City of Portland in April and June of 2010. As data were compiled from a variety of sources, no warranty is made as to the accuracy, reliability, or completeness of these data. Conveyance system information can be accessed at www.portlandmaps.com.
9. Aerial photos taken in July of 2009 by Metro.
10. PGE Station L sediment cap boundary approximated based on PGE Station L Phase II Final Report (CH2MHill, 1991).
11. Zidell-DEQ Sediment Management Area (SMA) boundary provided by Maul, Foster, Alongi (November 3, 2008).

N

1 inch = 1,700 feet

850 0 850 1,700
Feet

GSI Water Solutions, Inc.

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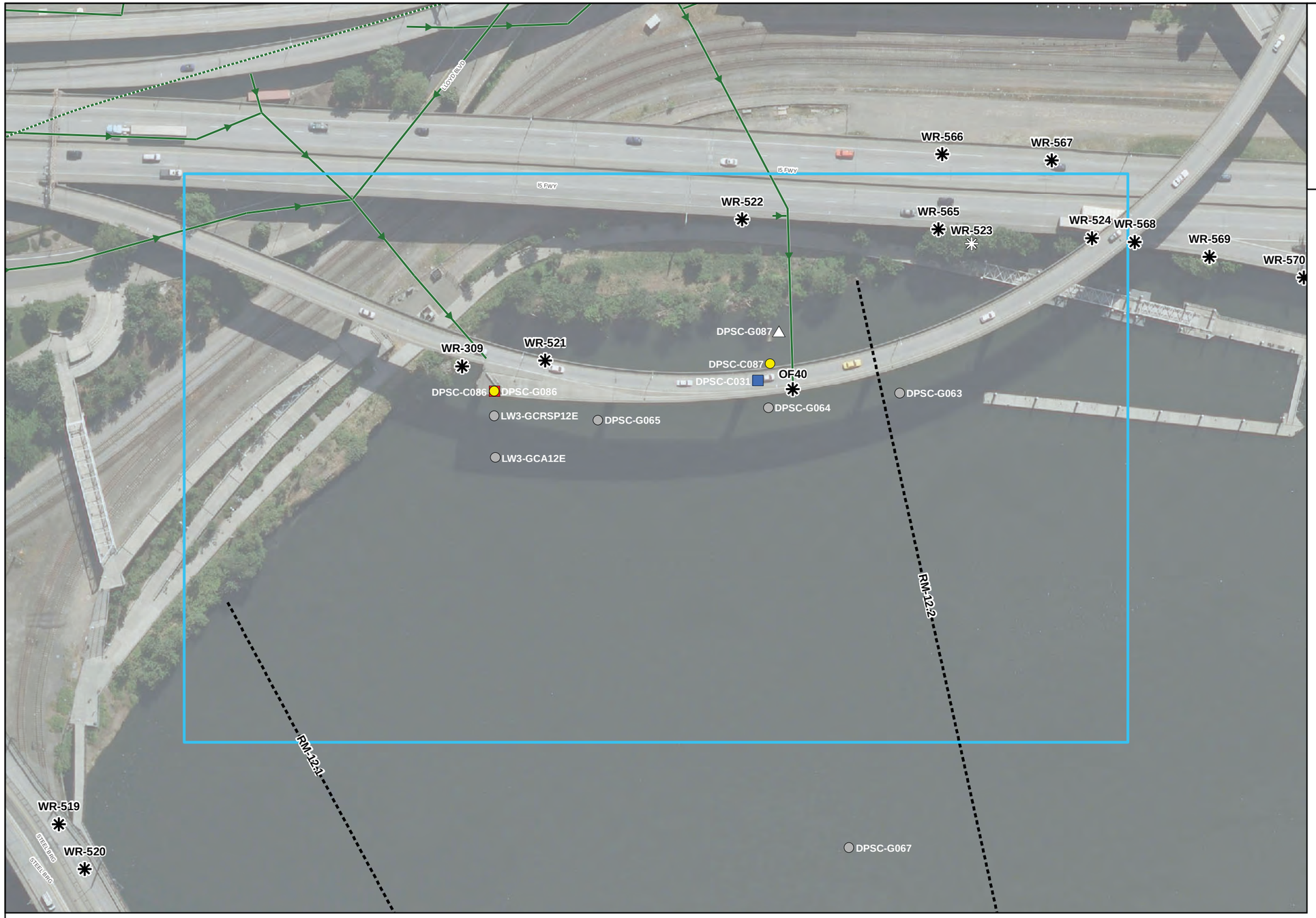
Figure 2

Sediment Sampling Locations

Focus Area RM12.1E

Downtown Portland Sediment Characterization Phase II Field and Data Report

Willamette River
Portland, Oregon



LEGEND

- DPSC Phase II Focus Area

DPSC Phase II Sediment Sample Location

- Grab Sample
- Core Sample
- Unsuccessful Grab Sample

Archived DPSC Phase I Sediment Sample Location

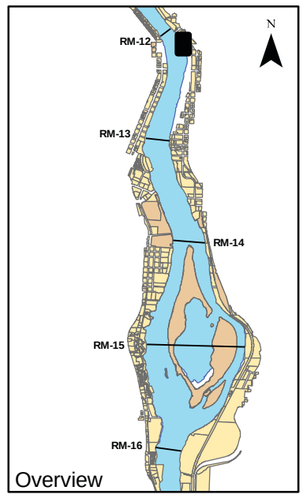
- Grab Sample
- Core Sample

Existing[6] Sediment Sample Location

- Grab Sample
- Core Sample

Other Data and Features

- Active Outfalls
- Outfalls with Inactive, Abandoned, or Unknown Status
- Combined Sewer/Stormwater Pipeline
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: June 11, 2010

1. The locations of all features shown are approximate.
2. DPSC = Downtown Portland Sediment Characterization.
3. PP&R = Portland Parks & Recreation.
4. RM11E = River Mile 11 East.
5. LWG = Lower Willamette Group.
6. Existing data includes DPSC Phase I, PP&R, RM11E, and LWG data.
7. Source of existing sediment sample locations is LWG SCRA Combo database (dated October 29, 2009), DPSC Field and Data Report (dated January 2009), and Draft RM11E Surface and Subsurface Sediment Field and Data Report (dated August 2009). Other sediment data might exist that are not included in the LWG SCRA Combo database or the DPSC Field and Data Report.
8. Outfall, combined sewer/stormwater pipeline, and stormwater pipeline data provided by the City of Portland in April and June of 2010. As data were compiled from a variety of sources, no warranty is made as to the accuracy, reliability, or completeness of these data. Conveyance system information can be accessed at www.portlandmaps.com.
9. Aerial photos taken in July of 2009 by Metro.

N

1 inch = 100 feet

50 0 50 100

Feet

GSI Water Solutions, Inc.

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 008 DPSC Phase 2\Project_GIS\Project_mxds\FDR\Figure4-1bto4-1j_Sediment_Samples.mxd, Date: June 11, 2010 10:36:28 AM

Figure 3
Third Quarter 2009 PCB Concentrations

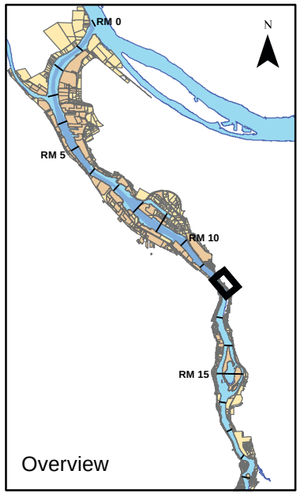
Willamette River Sediment Evaluation
Phase II Follow-up Summary

River Mile 11.6 to 12.2

Willamette River
Portland, Oregon

LEGEND

- RM11E Sediment Trap Location
- Existing RM11E, LWG, or DPSC Surface Sediment Sample Location
- Active Outfalls
- DEQ Focus Areas
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: May 31, 2011
1. The locations of all features shown are approximate.
2. LWG = Lower Willamette Group.
3. DPSC = Downtown Portland Sediment Characterization.
4. Source of existing sediment sample locations is LWG SCRA Combo database (dated July 7, 2009) and DPSC Field and Data Report (dated January 2009). Other sediment data might exist that are not included in the LWG SCRA Combo database or the DPSC Field and Data Report.
5. Outfall data obtained from the LWG's GIS shapefile entitled "Outfall_Oct_08.shp". Original source of information provided by the City of Portland in June of 2005. The location of outfall symbols were manually adjusted to better line up with stormwater piping. Stormwater pipeline data were provided to GSI Water Solutions by the City of Portland in February of 2009. As data were compiled from a variety of sources, no warranty is made as to the accuracy, reliability, or completeness of these data. Conveyance system information can be accessed at www.portlandmaps.com.
6. Aerial photos taken in July of 2010 by Metro.
7. Total PCB Congener concentrations are shown for in-river sediment traps and total PCB Aroclor concentrations are shown for existing surface sediment sampling locations.

Concentrations of PCBs[8]

- 0 - 34 ug/kg
- >34 - 75 ug/kg
- >75 - 150 ug/kg
- >150 - 300 ug/kg
- >300 - 1,000 ug/kg
- >1,000 ug/kg
- Not Detected
- Not Analyzed

1 inch = 300 feet

150 0 150 300
Feet

GSI Water Solutions, Inc.

File Path: P:\Portland\110 - BES\GIS\Project_MXDs\006_CONFIDENTIAL_SC\2_TO_15_RM11East\Focus_Area_12_1E\Figure3_Q3_2009_PCB_Concentrations.mxd, Date: May 31, 2011 4:07:01 PM

Figure 4

Sediment Sampling Locations

Focus Area RM12.4W

Downtown Portland Sediment Characterization Phase II Field and Data Report

Willamette River
Portland, Oregon

LEGEND

- DPSC Phase II Focus Area

DPSC Phase II Sediment Sample Location

- Grab Sample
- Core Sample
- Unsuccessful Grab Sample

Archived DPSC Phase I Sediment Sample Location

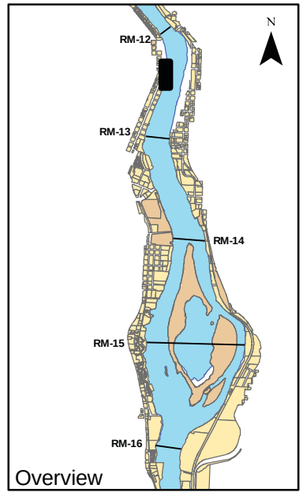
- Grab Sample
- Core Sample

Existing[6] Sediment Sample Location

- Grab Sample
- Core Sample

Other Data and Features

- Active Outfalls
- Outfalls with Inactive, Abandoned, or Unknown Status
- Combined Sewer/Stormwater Pipeline
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: June 11, 2010

1. The locations of all features shown are approximate.
2. DPSC = Downtown Portland Sediment Characterization.
3. PP&R = Portland Parks & Recreation.
4. RM11E = River Mile 11 East.
5. LWG = Lower Willamette Group.
6. Existing data includes DPSC Phase I, PP&R, RM11E, and LWG data.
7. Source of existing sediment sample locations is LWG SCRA Combo database (dated October 29, 2009), DPSC Field and Data Report (dated January 2009), and Draft RM11E Surface and Subsurface Sediment Field and Data Report (dated August 2009). Other sediment data might exist that are not included in the LWG SCRA Combo database or the DPSC Field and Data Report.
8. Outfall, combined sewer/stormwater pipeline, and stormwater pipeline data provided by the City of Portland in April and June of 2010. As data were compiled from a variety of sources, no warranty is made as to the accuracy, reliability, or completeness of these data. Conveyance system information can be accessed at www.portlandmaps.com.
9. Aerial photos taken in July of 2009 by Metro.

* DPSC-C041 collected in August of 2009 by Anchor QEA, LLC during the NW Natural sediment investigation of the former Portland Gas manufacturing site. Samples (core intervals A and B) were provided to the City of Portland for use in the DPSC Phase II.

N

1 inch = 150 feet

75 0 75 150

Feet

GSI Water Solutions, Inc.

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Figure 5

Sediment Sampling Locations

Focus Area RM12.5E

Downtown Portland Sediment Characterization Phase II Field and Data Report

Willamette River
Portland, Oregon

LEGEND

- DPSC Phase II Focus Area

DPSC Phase II Sediment Sample Location

- Grab Sample
- Core Sample
- Unsuccessful Grab Sample

Archived DPSC Phase I Sediment Sample Location

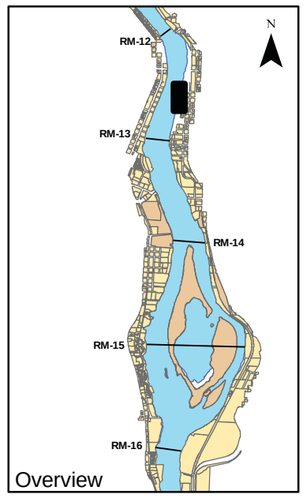
- Grab Sample
- Core Sample

Existing[6] Sediment Sample Location

- Grab Sample
- Core Sample

Other Data and Features

- Active Outfalls
- Outfalls with Inactive, Abandoned, or Unknown Status
- Combined Sewer/Stormwater Pipeline
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: June 11, 2010

1. The locations of all features shown are approximate.
2. DPSC = Downtown Portland Sediment Characterization.
3. PP&R = Portland Parks & Recreation.
4. RM11E = River Mile 11 East.
5. LWG = Lower Willamette Group.
6. Existing data includes DPSC Phase I, PP&R, RM11E, and LWG data.
7. Source of existing sediment sample locations is LWG SCRA Combo database (dated October 29, 2009), DPSC Field and Data Report (dated January 2009), and Draft RM11E Surface and Subsurface Sediment Field and Data Report (dated August 2009). Other sediment data might exist that are not included in the LWG SCRA Combo database or the DPSC Field and Data Report.
8. Outfall, combined sewer/stormwater pipeline, and stormwater pipeline data provided by the City of Portland in April and June of 2010. As data were compiled from a variety of sources, no warranty is made as to the accuracy, reliability, or completeness of these data. Conveyance system information can be accessed at www.portlandmaps.com.
9. Aerial photos taken in July of 2009 by Metro.

N

1 inch = 150 feet

75 0 75 150

Feet

GSI Water Solutions, Inc.

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Figure 6

Sediment Sampling Locations

Focus Area RM12.9W

Downtown Portland Sediment Characterization Phase II Field and Data Report

Willamette River
Portland, Oregon

LEGEND

- DPSC Phase II Focus Area

DPSC Phase II Sediment Sample Location

- Grab Sample
- Core Sample
- Unsuccessful Grab Sample

Archived DPSC Phase I Sediment Sample Location

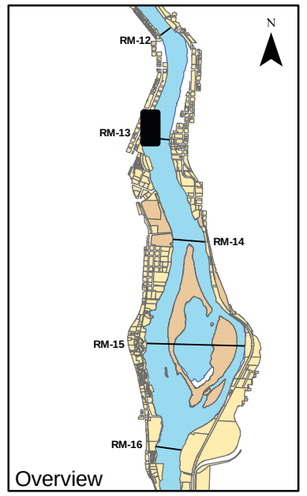
- Grab Sample
- Core Sample

Existing[6] Sediment Sample Location

- Grab Sample
- Core Sample

Other Data and Features

- Active Outfalls
- Outfalls with Inactive, Abandoned, or Unknown Status
- Combined Sewer/Stormwater Pipeline
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: June 11, 2010

1. The locations of all features shown are approximate.
2. DPSC = Downtown Portland Sediment Characterization.
3. PP&R = Portland Parks & Recreation.
4. RM11E = River Mile 11 East.
5. LWG = Lower Willamette Group.
6. Existing data includes DPSC Phase I, PP&R, RM11E, and LWG data.
7. Source of existing sediment sample locations is LWG SCRA Combo database (dated October 29, 2009), DPSC Field and Data Report (dated January 2009), and Draft RM11E Surface and Subsurface Sediment Field and Data Report (dated August 2009). Other sediment data might exist that are not included in the LWG SCRA Combo database or the DPSC Field and Data Report.
8. Outfall, combined sewer/stormwater pipeline, and stormwater pipeline data provided by the City of Portland in April and June of 2010. As data were compiled from a variety of sources, no warranty is made as to the accuracy, reliability, or completeness of these data. Conveyance system information can be accessed at www.portlandmaps.com.
9. Aerial photos taken in July of 2009 by Metro.

N

1 inch = 150 feet

75 0 75 150

Feet

GSI Water Solutions, Inc.

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 008 DPSC Phase 2\Project_GIS\Project_mxds\FDR\Figure4-1bto4-1j_Sediment_Samples.mxd, Date: June 11, 2010 10:36:28 AM

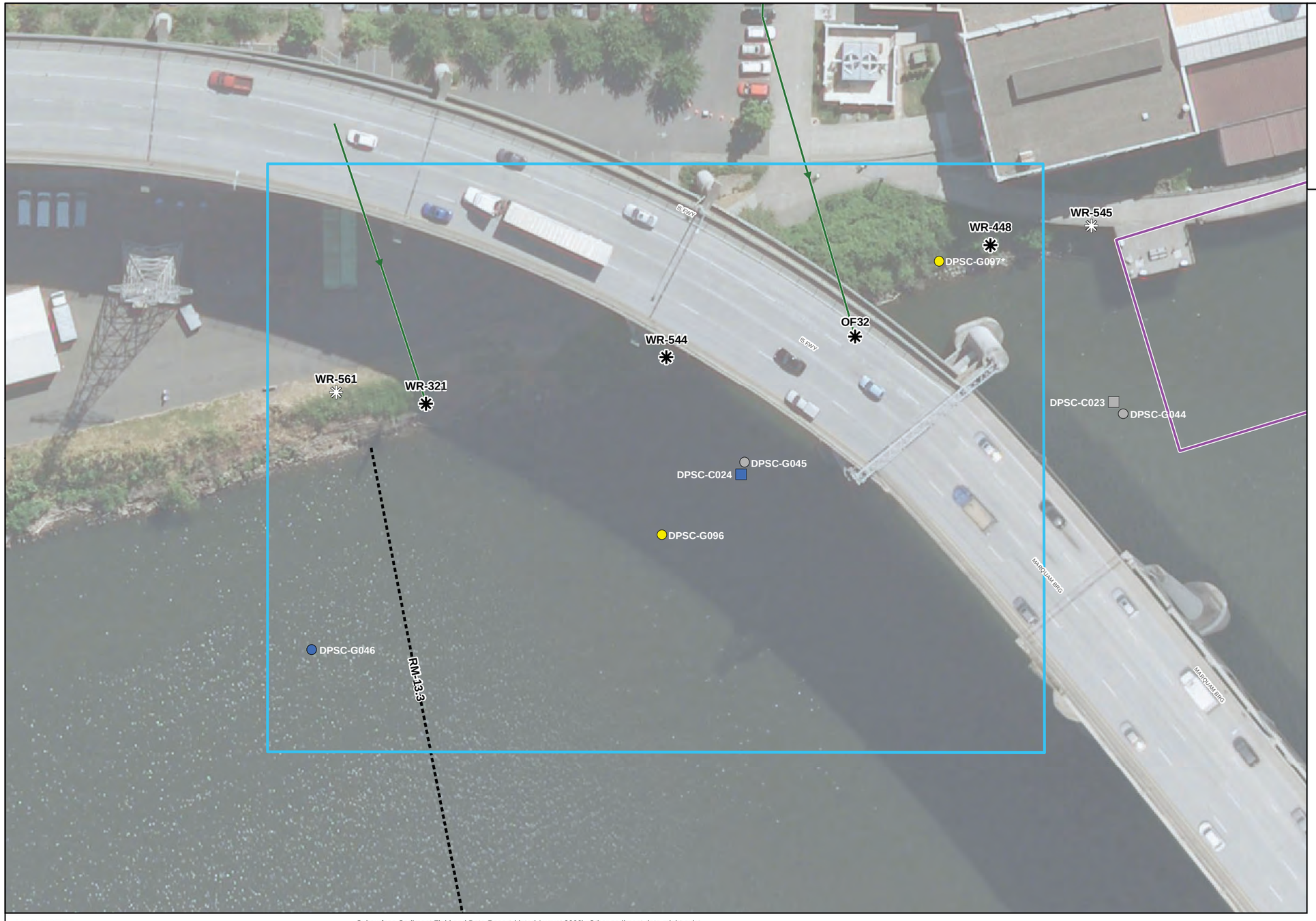
Figure 7

Sediment Sampling Locations

Focus Area RM13.3E

Downtown Portland Sediment Characterization Phase II Field and Data Report

Willamette River
Portland, Oregon



LEGEND

- DPSC Phase II Focus Area

DPSC Phase II Sediment Sample Location

- Grab Sample
- Core Sample
- Unsuccessful Grab Sample

Archived DPSC Phase I Sediment Sample Location

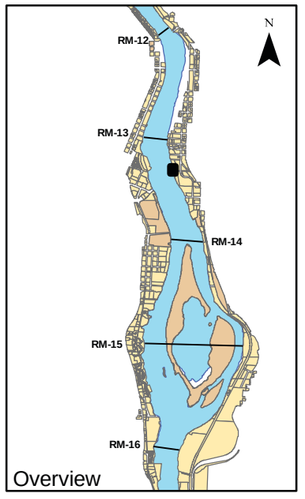
- Grab Sample
- Core Sample

Existing[6] Sediment Sample Location

- Grab Sample
- Core Sample

Other Data and Features

- Active Outfalls
- Outfalls with Inactive, Abandoned, or Unknown Status
- Combined Sewer/Stormwater Pipeline
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- PGE Station L Sediment Cap, Approximate
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: June 11, 2010
1. The locations of all features shown are approximate.
2. DPSC = Downtown Portland Sediment Characterization.
3. PP&R = Portland Parks & Recreation.
4. RM11E = River Mile 11 East.
5. LWG = Lower Willamette Group.
6. Existing data includes DPSC Phase I, PP&R, RM11E, and LWG data.
7. Source of existing sediment sample locations is LWG SCRA Combo database (dated October 29, 2009), DPSC Field and Data Report (dated January 2009), and Draft RM11E Surface and Subsurface Sediment Field and Data Report (dated August 2009). Other sediment data might exist that are not included in the LWG SCRA Combo database or the DPSC Field and Data Report.
8. Outfall, combined sewer/stormwater pipeline, and stormwater pipeline data provided by the City of Portland in April and June of 2010. As data were compiled from a variety of sources, no warranty is made as to the accuracy, reliability, or completeness of these data. Conveyance system information can be accessed at www.portlandmaps.com.
9. Aerial photos taken in July of 2009 by Metro.
10. PGE Station L sediment cap boundary approximated based on PGE Station L Phase II Final Report (CH2MHill, 1991).
*Sample DPSC-G097 was collected on-shore immediately adjacent to Outfall WR-448, and the sample location was estimated based on field measurements from several landmarks. The exact location of the sample and outfall is uncertain.

N

1 inch = 50 feet

25 0 25 50

Feet

GSI Water Solutions, Inc.

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 008 DPSC Phase 2\Project_GIS\Project_mxds\FDR\Figure4-1bto4-1j_Sediment_Samples.mxd, Date: June 11, 2010 10:36:28 AM

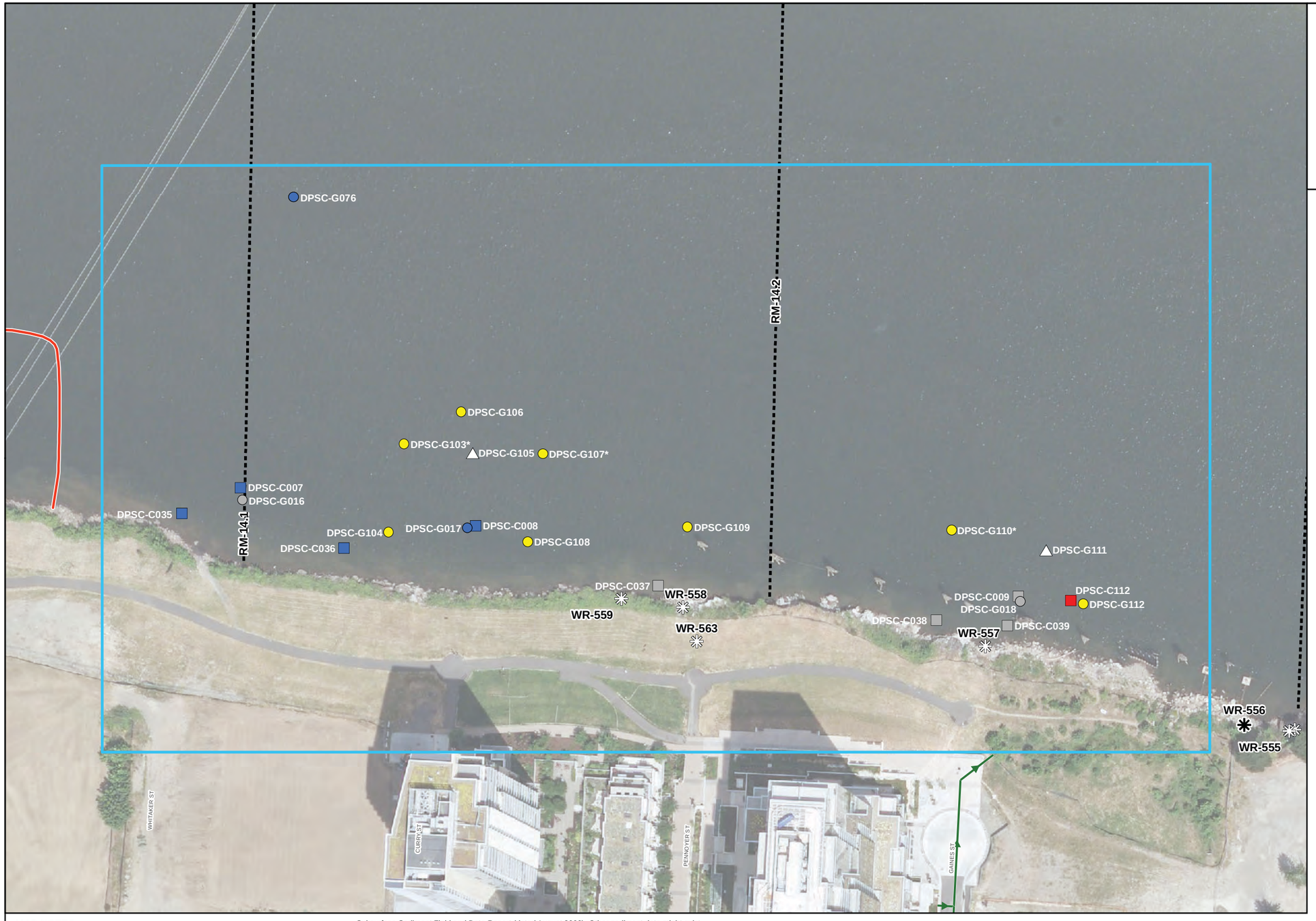
Figure 8

Sediment Sampling Locations

Focus Area RM14.1W

Downtown Portland Sediment Characterization Phase II Field and Data Report

Willamette River
Portland, Oregon



LEGEND

- DPSC Phase II Focus Area

DPSC Phase II Sediment Sample Location

- Grab Sample
- Core Sample
- Unsuccessful Grab Sample

Archived DPSC Phase I Sediment Sample Location

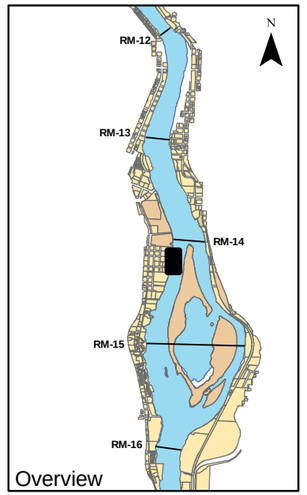
- Grab Sample
- Core Sample

Existing[6] Sediment Sample Location

- Grab Sample
- Core Sample

Other Data and Features

- Active Outfalls
- Outfalls with Inactive, Abandoned, or Unknown Status
- Combined Sewer/Stormwater Pipeline
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- Zidell - DEQ Sediment Management Area
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: June 11, 2010
1. The locations of all features shown are approximate.
2. DPSC = Downtown Portland Sediment Characterization.
3. PP&R = Portland Parks & Recreation.
4. RM11E = River Mile 11 East.
5. LWG = Lower Willamette Group.
6. Existing data includes DPSC Phase I, PP&R, RM11E, and LWG data.
7. Source of existing sediment sample locations is LWG SCRA Combo database (dated October 29, 2009), DPSC Field and Data Report (dated January 2009), and Draft RM11E Surface and Subsurface Sediment Field and Data Report (dated August 2009). Other sediment data might exist that are not included in the LWG SCRA Combo database or the DPSC Field and Data Report.
8. Outfall, combined sewer/stormwater pipeline, and stormwater pipeline data provided by the City of Portland in April and June of 2010. As data were compiled from a variety of sources, no warranty is made as to the accuracy, reliability, or completeness of these data. Conveyance system information can be accessed at www.portlandmaps.com.
9. Aerial photos taken in July of 2009 by Metro.
10. Zidell-DEQ Sediment Management Area (SMA) boundary provided by Maul, Foster, Alongi (November 3, 2008).
* These samples were collected and submitted to the laboratory for archival and potential future analysis.

N

1 inch = 100 feet

50 0 50 100

Feet

GSI Water Solutions, Inc.

File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 008 DPSC Phase 2\Project_GIS\Project_mxds\FDR\Figure4-1bto4-1j_Sediment_Samples.mxd, Date: June 11, 2010 10:36:28 AM

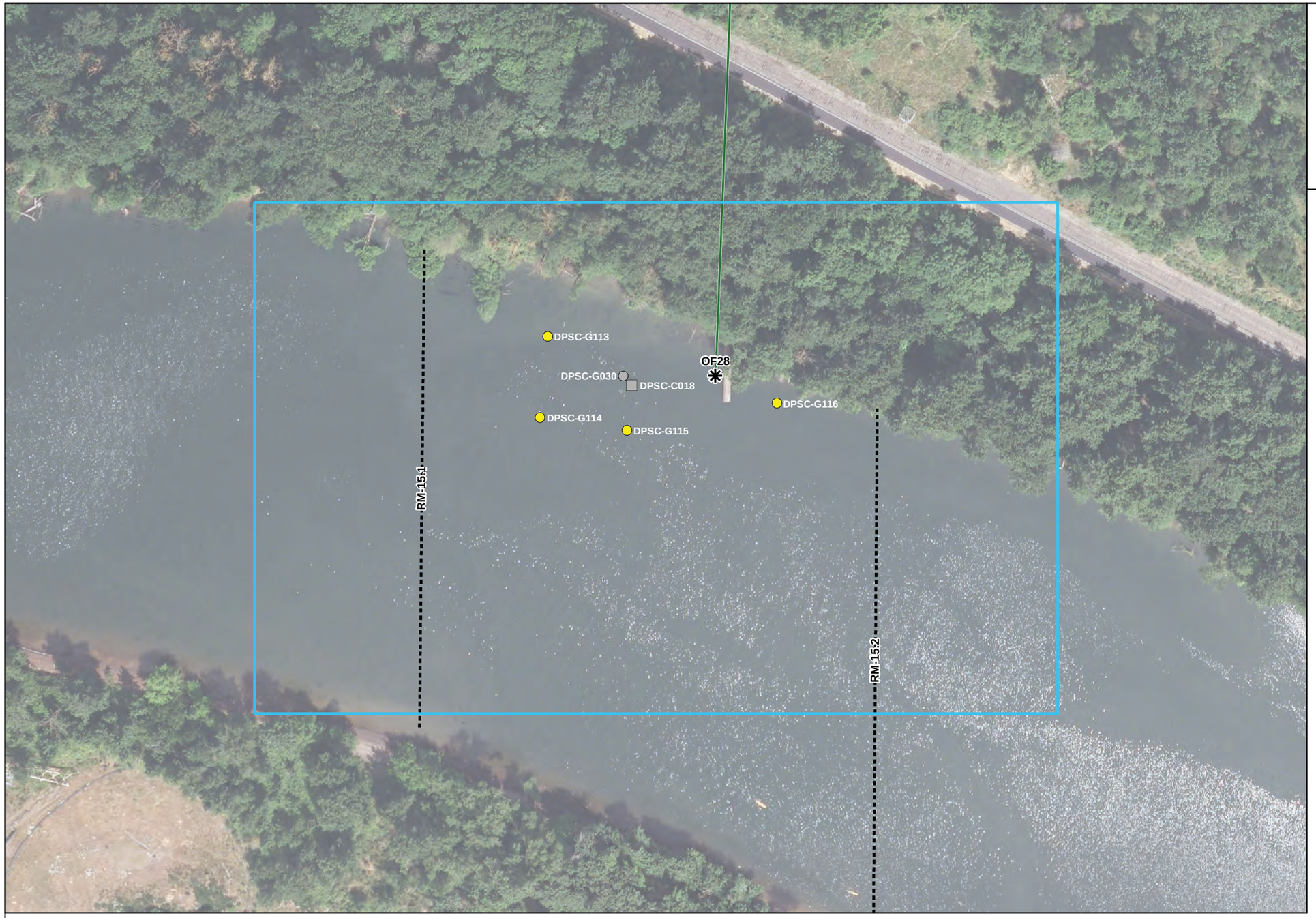


Figure 9

Sediment Sampling Locations

Focus Area RM15.1E

Downtown Portland Sediment Characterization Phase II Field and Data Report

Willamette River
Portland, Oregon

LEGEND

- DPSC Phase II Focus Area

DPSC Phase II Sediment Sample Location

- Grab Sample
- Core Sample
- Unsuccessful Grab Sample

Archived DPSC Phase I Sediment Sample Location

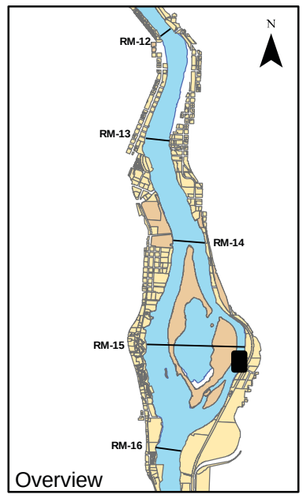
- Grab Sample
- Core Sample

Existing[6] Sediment Sample Location

- Grab Sample
- Core Sample

Other Data and Features

- Active Outfalls
- Outfalls with Inactive, Abandoned, or Unknown Status
- Combined Sewer/Stormwater Pipeline
- Stormwater Pipeline
- Abandoned Stormwater Pipeline
- River Mile (RM)



MAP NOTES:

Projection: Oregon State Plane North
Datum: North American Datum of 1983
Date: June 11, 2010

1. The locations of all features shown are approximate.
2. DPSC = Downtown Portland Sediment Characterization.
3. PP&R = Portland Parks & Recreation.
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9. Aerial photos taken in July of 2009 by Metro.

N

1 inch = 100 feet

50 0 50 100

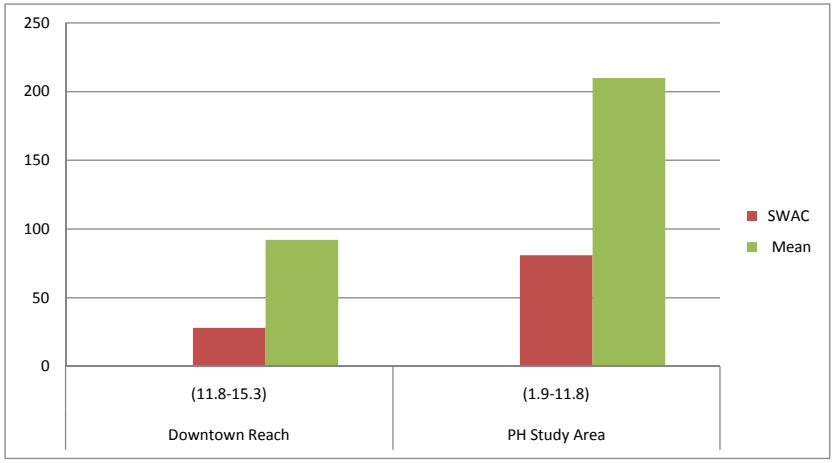
Feet

GSI Water Solutions, Inc.

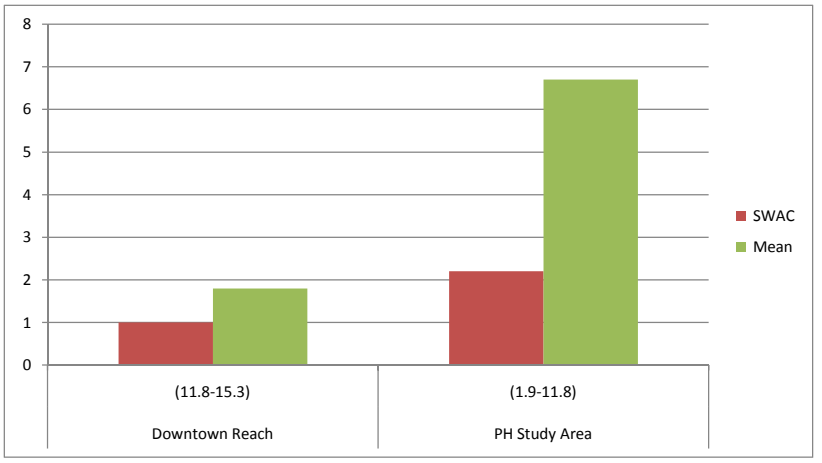
File Path: \\pdx\Projects\Portland\205 - OR DEQ\003 - 008 DPSC Phase 2\Project_GIS\Project_mxds\FDR\Figure4-1bto4-1j_Sediment_Samples.mxd, Date: June 11, 2010 10:36:28 AM

Figure 10 Downtown Reach/Portland Harbor
Statistical Comparisons

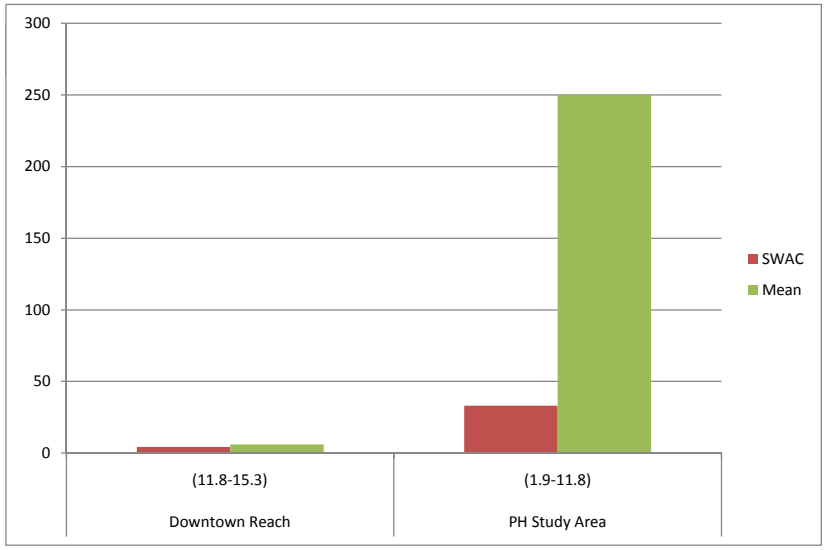
Total PCBs* ppb



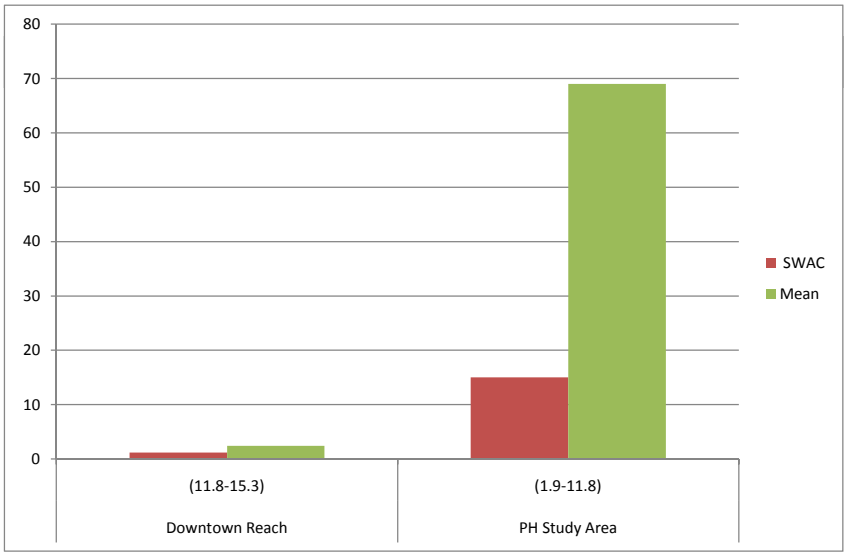
Total Chlordanes* ppb



Total DDXs ppb



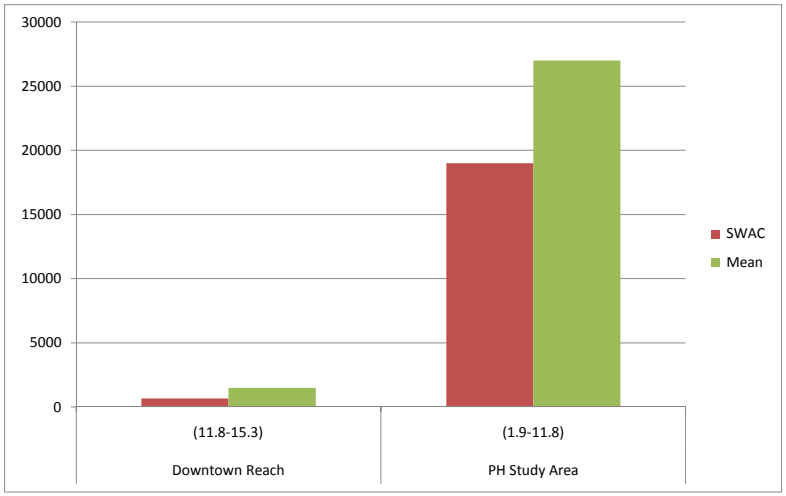
Dioxin TEQ pg/g



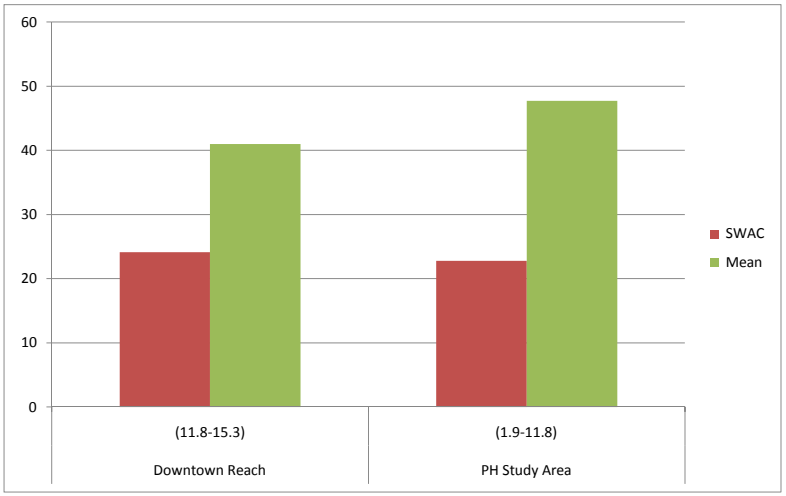
*Zidell data excluded from downtown reach

Figure 10 (continued) Downtown Reach/Portland Harbor
Statistical Comparisons

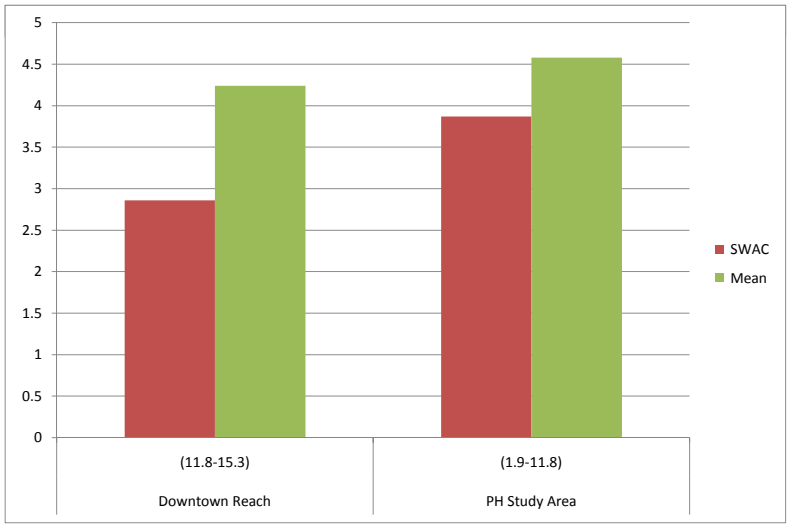
Total PAHs* ppb



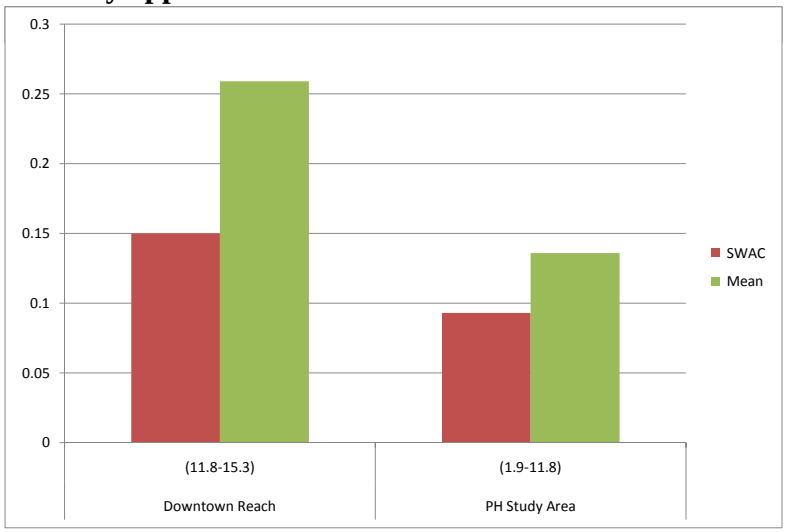
Lead* ppm



Arsenic* (ppm)



Mercury* ppm



*Zidell data excluded from downtown reach